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$T$  = time of perihelion passage.  
 $\pi$  = longitude of perihelion.  
 $\omega = \pi - \Omega$ .  
 $\Omega$  = longitude of the ascending node.  
 $i$  = inclination of orbit.  
 $e$  = eccentricity =  $\sin \phi$ .  
 $\phi$  = eccentric angle.  
 $a$  = semi-major axis, or mean distance.  
 $q$  = perihelion distance.  
 $\mu$  = mean daily motion.  
 $U$  = period of revolution.

The equinox to which the elements are referred is given, since the vernal equinox is continually shifting on account of the slow motion of precession.

With what has gone before, I think that very little need be said in explanation of fig. 3, which is drawn from a model made as I have just described. The true form of a portion of the comet's orbit is given, and upon it is projected the earth's orbit, which, with such a small value of  $i$ , appears here again as a circle. The positions of the earth and comet are given for several dates.

Fig. 4 shows the entire orbit of Barnard's comet (as well as that of Wolf's comet, presently to be mentioned), the earth's orbit, that of Mars, and a small portion of the orbit of Jupiter. These orbits are all represented in one plane, and on so small a scale the inclinations are not great enough to cause any appreciable distortion. For the comets, the lines of nodes and the major axes are drawn in. Perihelion in all of the orbits is marked  $P$ ; aphelion,  $A$ .

Fig. 5 is a map of a portion of the heavens showing the apparent path of the comet among the stars during the period of its visibility. It was in the constellation Lupus when first seen, and moved towards the north and east, through the constellations Scorpius, Sagittarius, Capricornus, and Aquarius. The place of the comet is given here, also, for July 16, the date of discovery; Aug. 16, perihelion passage; and Dec. 1, the limit of visibility.

**COMET 1884 III (WOLF).** — Wolf's comet, an insignificant object physically, is moving in an orbit of unusual interest. Its period is about six and three-fourths years. The entire orbit is shown in fig. 4, where two of the most interesting peculiarities are brought out, — a near approach to Jupiter in longitude  $209^\circ$ , May, 1875 (about eight million miles); and a near approach, at the descending node of the comet, to the orbit of Mars. From both of these planets the comet is evidently liable to considerable perturbation, and its past and future history become matters of some uncertainty.

Our chart shows a large part of the comet's apparent path in the heavens during its visibility.

WILLIAM C. WINLOCK.

#### GEOGRAPHICAL NOTES.

THE roll of geographical journals is increased by one. The Florentine section of the Italian African society has been authorized by the central council and treasurer to issue a bulletin, the first two fasciculi of which appeared recently. It is intended to be partly eclectic, presenting geographical and especially African news to its readers, and partly the official record of the proceedings of the section. The present number contains an address by Professor Licata on the rôle of Italy in the Red Sea, an article by A. Mori on Massowah, and other matters of the same sort; bibliography, including a notice of a number of papers on the zoölogy of Africa, which have appeared from time to time in the annals of the civic museum of natural history in Genoa; African notes; the proceedings of the society; and the annual address of Vice-president Stefanelli on the operations of the section for 1884. The new journal is free to members, or may be subscribed for at the secretary's office, Via San Gallo No. 33, Florence, at the rate of five lire per annum.

Dr. Sériziat has been for two years engaged in collecting Lepidoptera at Collo, in the more wooded district of Algeria, reaching some thirty-five hundred feet above the sea. He has obtained about a hundred and eighty-four species in all, — about as many as are ascribed to the whole of Algeria in the most recent catalogue. There are about fifty-two diurnal species, — just half as many as are found at Basle in Switzerland. The cause of this deficiency is stated to be the small number of succulent plants suitable for the food of larvae, and the incredible multitude of insectivorous birds. It would be a source of gratification if Collo would lend to America her surplus of the latter in place of our own inefficient wild birds; and our climate would, perhaps, be quite well suited to the Algerian birds, at least in certain regions.

On the occasion of the presentation to the Russian representative, of the gold Vega medal recently awarded by the geographical society of Stockholm to Prjevalski, Mr. Elfwing, the American consul, made an address on behalf of the society, which was much appreciated, and which has been reproduced in the 'Revue géographique' of Renaud. Mr. de Berends made a suitable response on behalf of the absent explorer. This is the third award of the medal, the previous recipients being Baron Nordenskiöld and Capt. Palander.

The death of Madam Carlo-Serena, author of geographical articles on the Caucasus, is announced as having occurred in 1884 at an obscure village — Oedips — in Greece, on the borders of the Aegean. She was chiefly noted for her passion for mountain travel, and the courage and energy with which she

bore the concomitant privations and physical exertion it required.

The first general assembly for 1885, of the Geographical society of Paris, took place on the 24th of April. The president, Mr. de Lesseps, gave a brief address, in which he touched upon the much greater sensitiveness to occurrences in little-known lands, which the extension of telegraphs and means of transportation has brought about among the more civilized nations; and the growing importance, from all points of view, of geographical instruction in schools, universities, and even in the reading-matter furnished the general public by the daily and periodical press.

Dr. Ballay, in an address on the new possessions of France in Africa, sums up by saying, that while the Ogowé can never be rendered navigable, it can at least be made useful for *bateaux*. Its basin is naturally fertile, and rich in resources. On the other hand, the country extending from this basin to the Kongo is generally sterile. Ivory is about the only product. There is little to hope for from this region; but it is the beginning of the practicable route for reaching the trade of the upper river, which has inhabitants of intelligence and thrift. The natural products of all this region, such as rubber, ivory, etc., may be expected to become rapidly exhausted. It should therefore be provided that artificial cultivation, new industries and crops, should be introduced and directed by the whites. In this way a permanent trade will arise, and commerce be permanently benefited.

From Iceland, under date of March 21, we learn that the shocks of earthquake which had devastated the vicinity of Husavik, North province, began Nov. 2, 1884, and continued at short intervals, but less energetically, until the 25th of last January. On this day stables were thrown down, springs burst from the ground in new places, and small elevations were visible in a formerly level sandy plain. It is singular that on every historical occasion when earthquakes have been felt in Spain, Iceland has simultaneously suffered: this may be due, however, to the prevalence of earthquakes in Iceland at all times.

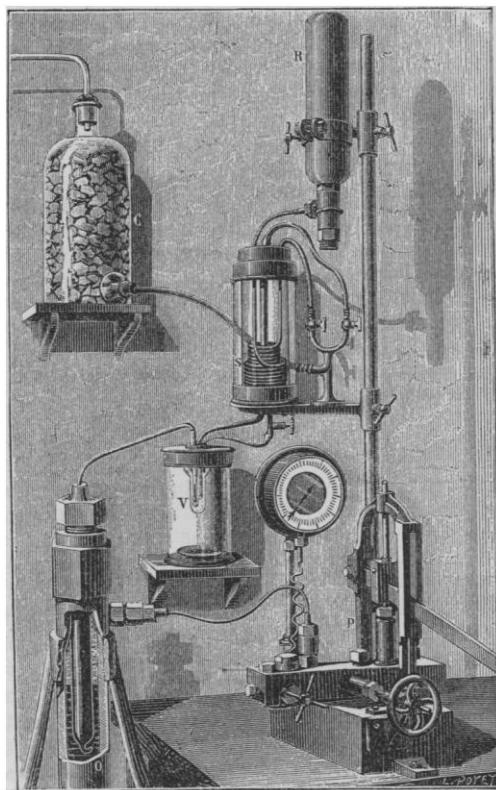
The Corwin has returned from Bering Sea to San Francisco for some repairs. She reports the sea ice unusually far south in April and May in that sea. No whales had yet been taken.

#### THE LIQUEFACTION OF OXYGEN.<sup>1</sup>

Liquid ethylene, the use of which I have already explained to the Académie des sciences, furnishes, when boiled in the open air, a cold sufficient to cause oxygen, if compressed and reduced to this temperature, to present, when the pressure is diminished, a hard boiling appearance, which continues for an appreciable time. By evaporating the ethylene by the air-pump, the temperature is sufficiently lowered to

reduce the oxygen to a liquid state. I have endeavored to avoid the inconvenience and complication which result from working in a vacuum, and to this end have already suggested the use of liquid methane, by means of which the liquefaction of oxygen and nitrogen may be easily brought about.

I thought, however, that, notwithstanding these advantages, ethylene, which is so easily prepared and handled, ought to be preferred to methane; and, by means of ethylene boiled in open jars, I have succeeded



CAILLETTET'S APPARATUS FOR THE LIQUEFACTION OF OXYGEN.

in reducing the temperature sufficiently to cause the complete liquefaction of oxygen. The process I use is very simple, and consists in evaporating the ethylene by forcing into it a current of air or of hydrogen at a very low temperature. In my apparatus, the steel receiver *R*, which contains the liquid ethylene, is attached to a copper worm three or four millimetres in diameter, closed by a screw-tap arranged in a glass jar, *S*. On turning into this jar some chloride of methyl, the temperature falls to  $-25^{\circ}$ ; but if we blow into this air which we have dried by passing it through a flask, *C*, containing chloride of calcium, we soon have a cold of  $-70^{\circ}$ . The ethylene thus cooled condenses, and fills the worm. When the tap is opened at the base of the jar *S*, the ethylene flows

<sup>1</sup> Condensed from *La Nature*, May 16.